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A LINEAR APPROACH FOR OPTIMIZING ENERGY IN WIND TURBINES BY EMBEDDING PROCESS

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Abstract. *This paper presents an optimal control structure for variable speed, fixed pitch wind turbine. The control objective results from optimizing the integral of a quadratic function that includes two contradictory demands: maximization of the energy captured from the stochastic wind behavior and minimization of the damage caused by mechanical fatigue. This trade-off in the combined performance criterion is realized by choosing the coefficient α. In this study, the optimal control law is obtained by a new approach based on the linearization of stochastic system and linear properties of measures. Representing the problem in variational form, transferring to a measure space globally and determining the optimal strategy via a finite linear programming are the steps of this approach. The method has many advantages compared with others like easy computational method, globality and guarantees the existence of solutions. The presented numerical simulations show a better efficiency as well. Also, the optimal value for α is calculated by Genetic Algorithm.*

Keywords: Optimal control, Radon measure, Optimizing wind power, Linear programming, Wind turbine

1. **Introduction.** Nowadays, using renewable energies is an increasing area of research and development in all the world, because they are important alternatives to generate economical and clean power. Wind energy has steadily established itself as one of the most reliable and affordable renewable energy resources and it is, currently, the fastest-growing source of electricity in the world. Therefore, exploitation from wind energy through wind turbines in order to produce electricity has been taken into consideration. Optimization of energetic efficiency in variable speed fixed pitch wind turbines is the main purpose of studies about designing and exploitation from the wind turbines.

The control problem associated with the wind energy conversion systems consists essentially in optimizing the energy conversion, namely in maximizing the energy captured from the wind. One of the previous studies used variable speed electrical generators in conjunction with nonlinear control algorithm [1]. Also, Wood used differential evolution to optimize wind turbine blades [2]. Liu, Chen and Ye presented an optimization model for rotor blades of horizontal axis wind turbine and their model refers to the wind speed distribution function [3]. Moreover, power optimization objective is gained by computing optimal control settings of wind turbines using data mining and evolutionary strategy [4].

Supposing that the energy of the moving wind would be fully captured by means of a turbine rotor, the total power provided to the rotor would be:

$$P_t = \frac{1}{2}\,\rho a\, V^3, \tag{1}$$